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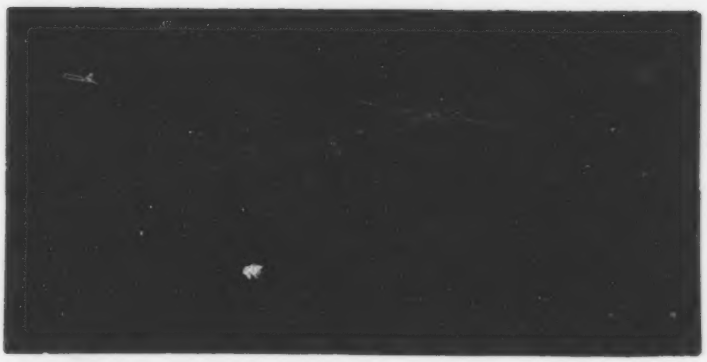

Canada

A SURVEY ON PERCEIVED RISKS

by

Gilbert Lafond and Andrée Gosselin
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ABSTRACT

The study of perceived risks is of great importance to policy makers in assessing the acceptability of risks. Emergency Preparedness Canada (EPC) is therefore interested in finding out methods of ranking and prioritizing perceived risks in a way which is simple to use and which provides reliable consensus values. However, on doing research into risk perception and studies on resources allocation to various mitigation measures, it is suggested that risks are not evaluated in a consistent manner by laypersons and experts alike. The survey work that follows is an attempt to assess and compare two alternate approaches to perceived risk measurement. This research was initiated at the EPC 1986 Symposium on Risk Management . The sample of respondents comprises experts in risk assessment and specialists in emergency planning who attended the symposium. The same questionnaire was recently administered to a small sample of emergency planning staff on course at the Canadian Emergency Preparedness College in Arnprior, Ontario.

The sub-set of risks under consideration and the fielded questionnaire were designed to allow for several interesting comparisons between methods, between respondents categories as well as within them. Comparisons with other researchers' results are also made. One of the two methods, the Analytical Hierarchy Process method (AHP), does not only provide ordinal and relative scale comparisons but also a consistency indicator for each of the respondents. Based on the observed values of that indicator, some respondents will be eliminated from consensus calculations unless appropriate corrective action is taken to bring back consistency within acceptable boundaries. This study, although preliminary, shows again that assessing perceived risk is not done in a consistent manner. The advantages of the AHP method are commented on and alternate ways to measure risks are outlined.

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A SURVEY ON PERCEIVED RISKS

Introduction

A survey comprising three major questions and 47 sub-questions on risk knowledge and perception was administered to evaluate two methods of ranking and prioritizing perceived risks, to assess the consistency of respondents' answers and to compare rankings and scalings given by the different methods as well as between respondents' categories. The questionnaire, which appears at Annex A along with some tabulated frequency data on most of the responses, addresses a sub-set or list of well known activities, products or technologies that could represent a risk. In the introduction to the questionnaire and in the instructions provided to respondents, the word "risk" stood for the potential for accidental incapacitation or casualty, the chance of dying immediately or in the future as a result of exposure to any one of the listed activities or substance. The list of risks of the survey was extracted from Slovic, Fischhoff and Lichtenstein (Ref.1) to allow for subsequent comparisons with "reference" data on ranks or scales. Those researchers used a direct assessment approach that only requires the respondents to rank the elements by decreasing associated risk (see Table 1). Comparisons with Slovic's reference data will therefore be limited to rank discrepancies.

The questionnaire was administered to a sample of emergency specialists and experts attending the EPC Symposium on Risk Management. Although keen on risk issues, most respondents rated themselves as moderately knowledgeable as shown by responses to the first question. No attempt was made to balance the sample to optimize its representativeness.The whole exercise should therefore be looked at as an experiment with risk assessment methods.

The two methods under evaluation in this paper are :

- A ***Direct Assessment*** method for perceived risks, where respondents are asked to sort or rank/order a given list of risks in decreasing order of severity on a scale of 1 to 10 . This is designated as the Borda-Kendall method introduced by Borda in 1781 (Jensen, Ref.2). Once the least risky item/activity of the list has been determined, respondents then compare the other elements of the list to it by specifying how many times riskier they find these to be. Ordinal and numerical scales are then obtained directly.

- A ***Paired-Comparison*** of the risks: respondents are asked to compare any two elements of the list on the basis of their associated risks. The results of this paired comparison are subsequently analyzed using the Analytic Hierarchy Process (AHP) developed by Thomas L. Saaty (Ref.3). A consistency index is calculated and, from the numerical scale, the ranks of the various risks are worked out.

The Direct Method

This method is straightforward as the only computation required is the calculation of the average ranking for the Borda-Kendall method and the average scaling for the ratio-scale one, to determine the consensus.

The Paired-Comparison Method

Known as the analytical hierarchy process, this method is well documented in many papers and has been applied to various decision situations. A one-hierarchy application of the method is considered in this study: risks are compared on the basis of their relative severity. No other factor or criterion is used in the questionnaire nor in the analysis. Of course, a multi-criteria approach would call for a number of questions which might turn out intractable for the respondents.

In the case of the EPC survey, 10 different risks are considered by a group of people consisting of the Symposium attendees. The 10 original questions require that $(n^2-n)/2$ paired comparisons be made where n=10 represents the number of risks under study. Our goal is to have the sample of respondents provide their own value judgement on the relative severity of these risks. The AHP method, by an adequate breakdown of the questions in a series of paired comparisons and because of its built-in consistency index, should ensure that these judgements are quantified to an extent that will permit a quantitative interpretation of the survey's results.

Let $R_1,...,R_n$ be the n risks or activities that are being compared. The quantified judgements on pair R_i,R_j are represented by a nxn matrix called the dominance matrix:

$$A=(a_{ij}), \quad (i,j=1,...10).$$

with

$a_{ij}=q$ then $a_{ji}=1/q$, $q \neq 0$ [forced reciprocals]

$a_{ij} = a_{ji}$ whenever R_i is considered as risky as R_j

$a_{ii}=1$ for all i's.

The resultant dominance matrix A becomes :

$$A= \begin{bmatrix} 1 & a_{12} & .... & a_{1n} \\ 1/a_{12} & 1 & .... & a_{2n} \\ .... & & 1 & ... \\ .... & & ... & ..1 \\ 1/a_{1n} & & .... & ..1 \end{bmatrix}$$

TABLE 1 : RANK ORDERING OF PERCEIVED RISKS

Group #	1	2	3	4
	LOWV	College Students	Club Members	Experts
* Nuclear Power	1	1	8	20
* Motor Vehicles	2	5	3	1
Handguns	3	2	1	4
* Smoking	4	3	4	2
* Motorcycles	5	6	2	6
Alcoholic Beverages	6	7	5	2
General Private Aviation	7	15	11	12
* Police Work	8	8	7	17
* Pesticides	9	4	15	8
* Surgery	10	11	9	5
Fire Fighting	11	10	6	18
Large Construction	12	14	13	13
Hunting	13	18	10	23
Spray Cans	14	13	23	26
Mountain Climbing	15	22	12	29
Bicycles	16	24	14	15
* Commercial Aviation	17	16	18	16
Electric Power	18	19	19	9
Swimming	19	30	17	10
* Contraceptives	20	9	22	11
Skiing	21	25	16	30
X-rays	22	17	24	7
College Football	23	26	21	27
Railroads	24	23	20	19
* Food Preservatives	25	12	20	14
Food Colouring	26	20	30	21
Power Mowers	27	28	25	28
Prescription Antibiotics	28	21	26	24
Home Appliances	29	27	27	22
Vaccinations	30	29	29	25

* *Risk used in the EPC survey*

Under the assumption that the judgements are "precise", one can assume that if R_i and R_j are given "weights" of w_i and w_j respectively, the judgement a_{ij} can be simply expressed as :

$$a_{ij} = w_i/w_j \quad \text{for } i,j=1,\ldots 10$$

and

$$A = \begin{bmatrix} w_1/w_1 & \ldots & & \ldots & w_1/w_{10} \\ w_2/w_1 & w_2/w_2 & & \ldots & w_2/w_{10} \\ & \ldots & \ldots & \ldots & \\ w_{10}/w_1 & \ldots & \ldots & & w_{10}/w_{10} \end{bmatrix}$$

This naturally represents the "ideal" case, which means that considering a row i, and premultiplying it by w_i (i= 1,...,10) one gets:

$$(w_1,w_2,\ldots w_{10})x(w_i/w_1,w_i/w_2,\ldots,w_i/w_{10}) = (w_i,w_i,\ldots,w_i)$$

In reality, instead of obtaining a constant vector of w_is one would observe a vector of statistically scattered values around the true "w_i" because of deviations in human judgements which are not always consistent nor necessarily transitive, intransitivity being the worst case of inconsistency.

So an alternate way to the estimation of $w_i=a_{ij}w_j$, is to take the average value:

$$w_i = \frac{1}{10} \sum_{j=1}^{10} a_{ij}w_j \qquad \text{for } i=1,\ldots,10$$

Consistency and Transitivity

If one defines consistency and transitivity as follows:

A matrix $A=(a_{ij})$ is consistent if $a_{ik}=a_{ij}.a_{jk}$ for all js

A relation "r" is transitive if $R_1 \; r \; R_2$ and $R_2 \; r \; R_3$ implies that $R_1 \; r \; R_3$

Matrix A will not be consistent if the relations between the a_{ij}s are not transitive, nor if they are not multiplicative.

Consistency therefore offers a way to check the quality of the responses : consensus ranking/scaling should be derived from all responses considered consistent as any respondent failing the consistency check should be discarded or offered the opportunity to reconsider his or her response.

Calculating a Scale

Under the assumption that responses are consistent, the maximum eigenvalue of dominance matrix A should equal n, the sum of the diagonal elements of A, but as there is a perturbation of the ratios w_i/w_j, the variation of the maximum eigenvalue about n provides a consistency yardstick. This value, λ_{max} gives a unique solution to the problem (Perron-Frobenius):

$$w_i = \frac{1}{\lambda_{max}} \sum_{j=1}^{10} a_{ij} w_j \qquad i=1,...,10$$

Because the matrix A is reciprocal, this leads to a stable solution of:

$$A'w' = \lambda_{max} w'$$

where A' is a reciprocal matrix and a perturbation of matrix A and w' is the eigenvector associated to λ_{max}.

The above equation can be solved iteratively for λ_{max} and its corresponding eigenvector by means of the power method, which is adequate in this context (Ref. 4). The solution process provides the analyst with three interesting measures :

1. the normalized eigenvector (i.e. an approximation to w_i's) or priority vector from which the relative risk scale for the activities under comparison can be derived

2. from the eigenvector-based scale, ranks for the list of risks can be obtained easily

3. a consistency ratio index for each respondent or group thereof can also be calculated from the discrepancy between λ_{max} and the value of n.

The values S_i's of the numerical scale $S=\{ S_i \mid i=1 \text{ to } n\}$ are calculated by inverting the eigenvector (subtracting the w_i' scores from their largest and smallest eigenvector components), normalizing it and multiplying it by the sum of ranks, i.e. :

$$S_i = (n(n+1)/2) \times [\max_i[w_i'] + \min_i[w_i'] - w_i']$$

Consistency Index and Ratio

The index of consistency is defined as:

$$IC = (\lambda_{max} - n)/n-1$$

IC indicates how far λ_{max} is from n (the ideal value for λ_{max}). When divided by a random consistency index or a normalization factor which is actually the IC of a randomly filled matrix with forced reciprocals, IC becomes the consistency ratio (CR) of a response. Depending on the calculated CR, the value judgement of a respondent can be accepted or rejected. Empirical research by Saaty (Ref. 3) suggests that an observed consistency ratio over 0.1 indicates that the provided paired comparisons are not consistent enough. The implication, of course, is that individual respondents with consistency ratio greater than 0.1 should be rejected from the sample unless appropriate corrective action is taken to reduce the observed inconsistencies.

Results: Scales, Ranks and Consistency

Table 2 shows the overall ranking and scaling of the moderately knowledgeable respondents, given by the direct Mean Ranking method, the AHP method and the ranking given by some U.S. experts. As all these methods create continuous solutions from ordinal inputs, a threshold tie-rule should be defined, although in our case, ties are not really important . Those results were obtained after censoring the sample on the basis of respondents' consistency.

As can be noted in Fig. 1, the consistency ratios of the respondents are quite high. The frequency histogram does show a peak at CR=0.175, a value well in excess of Saaty's 0.10. In addition, the observed frequency distribution appears bimodal. That second peak, of course, pinpoints to a sub-set of respondents who are really inconsistent and should be discarded from the survey. To proceed with the evaluation of the ranking and scaling, we have made the working assumption that an individual CR of 0.25 is acceptable. That threshold value might change as more survey results become available. It is an empirical attempt to account for the fact that CR is dependent on the coding of the scales as provided by respondents. An illustration of this is as follows: if a respondent considers R_1 to be riskier than R_2 (i.e. three times riskier) and R_2 a lot riskier than R_3 (i.e. six times riskier), then perfect cardinal consistency would imply that R_1 is 18 times riskier than R_3 . Since the value of 18 is not in the coding scheme, six is taken as the most consistent response possible, this increases the value of CR and might induce some inconsistency in the evaluation by individual respondents. It may also happen that the chosen scale might not be reflecting the real shape of the perceived risks function. Riskiness as a function may have an exponential or any other shape such that the consistency relation defined above does not necessarily hold. It is to be noted that uncompleted questionnaires were discarded. It would seem that application of the AHP to risk scaling would require additional research particularly in the area of scale coding.

The results of Fig 1, however, do confirm findings from an experiment conducted by U.S. researchers (Ref. 5) emphasizing that it is difficult to be consistent when dealing with risks. Table 3 shows their results on perceived risks where questions asked in four different ways, led to four distinct scales from the same sample of respondents.

TABLE 2 : RANKS AND SCALES

Moderately Knowledgeable Respondents

	AHP		DIRECT		SLOVIC
	Scale	*Rank*	*Scale*	*Rank*	*Rank*
Motorcycles	1.14	1	1.90	1	4
Motor Vehicles	3.94	2	3.26	3	1
Smoking	3.99	3	3.08	2	2
Surgery	5.22	4	4.37	4	3
Police Work	5.43	5	4.50	5	9
Pesticides	6.65	6	5.55	6	5
Nuclear Power	6.90	7.5	8.08	8.5	10
Aviation	6.90	7.5	8.08	8.5	8
Contraceptives	7.34	9	8.11	10	6
Food Preservatives	7.43	10	7.89	7	7

FIGURE 1 : CONSISTENCY RATIOS

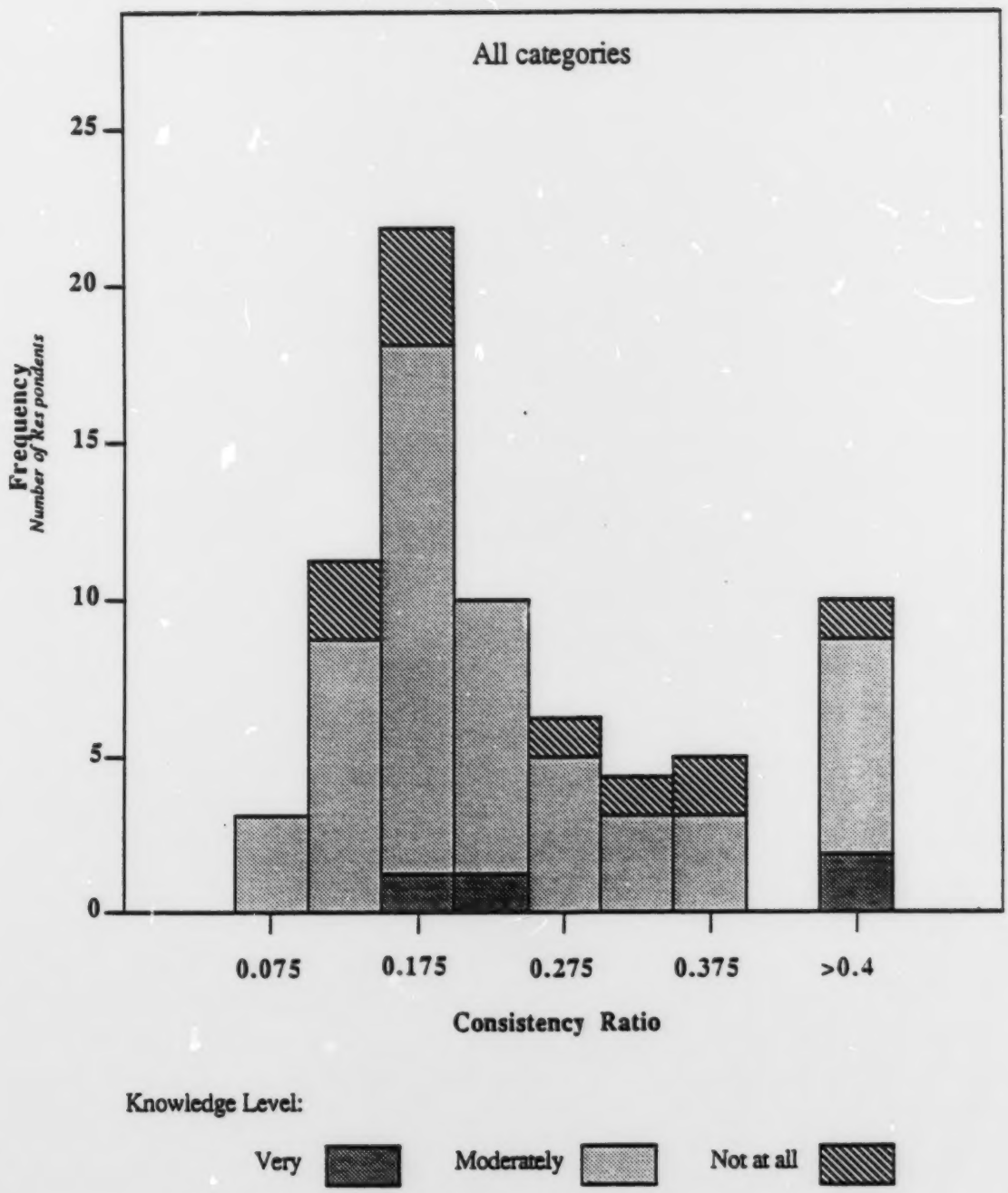


TABLE 3 : DIRECT AND CONVERTED LETHALITY RATES

Death rate per 100,000 affected

Estimation Method	*Direct Death Rate*	*Number Died*	*Survival Rate*	*Number survival*	*Statistical Death Rate*
Dental Problems	10	1	2	1	1
Influenza	393	6	26	511	0
Mumps	44	114	19	4	12
Skin Diseases	63	4	6	641	30
Asthma	155	12	14	599	33
Alcoholism	559	70	13	294	44
Venereal Diseases	91	63	8	111	50
Measles	52	187	18	28	75
High Blood Pressure	535	89	17	538	76
Drug Abuse	1020	13	71	19	95
Bronchitis	162	19	43	2111	85
Pregnancy	67	24	13	787	250
Diabetes	487	101	52	5666	800
Emphysema	1153	1998	70	5417	1423
Tuberculosis	852	1783	188	8520	1535
Pneumonia	563	304	77	9553	1733
Auto Accidents	6195	3272	31	6813	2500
Strokes	11011	4648	181	24758	11765
Heart Attacks	13011	3666	131	27477	16250
Cancer	10889	10475	160	21749	37500
Concordance coefficient	***0.62***	***0.67***	***0.34***	***0.67***	

TABLE 4 : RISK MAGNITUDE DATA

(Times riskier than least risky element)

RISK	**Respondent #1**		**Respondent #2**	
Aviation	2	x riskier	200	x riskier
Contraceptives	1	"	5	"
Food Preservatives	least risky element		2	"
Motorcycles	5	x riskier	1,000,000	"
Motor Vehicles	7	"	10,000	"
Nuclear Power	3	"	least risky element	
Pesticides	2	"	10	x riskier
Police Work	2	"	100	"
Smoking	4	"	100	"
Major Surgery	6	"	100,000	"

TABLE 5 : DIRECT RATIO-SCALE RESULTS

RISK	Direct Scale*	Rank*
Aviation	1.62×10^2	8
Contraceptives	6.58×10^1	9
Food Preservatives	2.63×10^5	3
Motorcycles	2.64×10^7	1
Motor Vehicles	2.69×10^6	2
Nuclear Power	1.49×10^1	10
Pesticides	2.86×10^3	6
Police Work	8.35×10^2	7
Smoking	5.99×10^4	4
Surgery	2.89×10^4	5

* Compiled results based on a sample size of n=38 with CR < 0.25

Advantages and Disadvantages

A problem with the Borda-Kendall method is that it assumes that each respondent is able to rank risks on an ordinal scale of 1 to 10, which is not always the case. When one looks at the different categories of respondents (ranging from city engineers, administrators to social scientists) who filled out the questionnaire, one observes that in the direct assessment's ratio-scale, different orders of magnitudes are used depending on the respondent's background (see Table 4). As can be seen in Table 5, we have derived the results for the direct Ratio-Scale, but there are too many discrepancies between the scales used by each respondent, different orders of magnitude are being used and therefore we did not consider the results valid.

The paired comparison method has many advantages: a qualitative scale is used, eliminating the "all at once" ranking as ranks are deduced from the obtained scales. It gives a way to check respondents' consistency; consensus preference ranking and scaling (given by the whole group) are easy to derive. The AHP calculations for each respondent or for the consensus results are easy and reasonably fast to determine using microcomputers.

Coding Scales

While ranking several risks seems rather straightforward, putting them on a numerical scale is more demanding for respondents and the analysts alike. When respondents are asked to position various risks on a continuous numerical scale, no assumption can be made that each respondent is referring to an identical scale on which to base the comparisons. A way around this is to provide the respondents with an adjectival evaluation or a qualitative scale (see sample questionnaire, Annex A) which will require some subsequent numerical coding by the analysts.

Some problems, however, arise when trying to numerically code scales from an adjectival evaluation. The scale used for comparisons of the 10 elements is a numerical one although this might not be apparent to respondents. The respondent has to answer whether an element is perceived as much less risky, less risky , the same, riskier or a lot riskier than the other elements in the list. Under AHP, each adjective assessment is actually assigned a numerical value ranging from 1/6 (a lot less risky) to 6 (a lot riskier) which will be used in the AHP calculations. As different respondents may apply the scale using different interpretations of the adjectives which describe the units of the scale, the above arbitrary numerical assignment is to be used with care.

Revised Judgement

A heuristic scheme for reducing inconsistencies can be used as suggested by Saaty (Ref. 3). From the matrix of priority ratios w_i/w_j, the matrix of absolute differences $|a_{ij}-(w_i/w_j)|$ is then calculated and the judgements with the largest calculated absolute differences are revised first. Alternately, one can form the root mean square deviation using the rows of (a_{ij}) and w_i/w_j and revise the judgements for the row with largest value. The procedure consists of replacing all a_{ij} by the w_i/w_j and recalculating the priority vector. These techniques were not applied to the EPC survey because they are considered as forcing the consistency.

Consensus Reaching

For each category of respondents, the individual scalings and rankings were aggregated to form what are called a consensus scaling and ranking. Two ways of obtaining this consensus were considered. The first derives the ranking from the scaling given by the arithmetical means of the calculated eigenvector of each respondent's dominance matrix as described in this paper, while the second method works out ranking and scaling from geometric means of the responses.

In the second case, the scaling is given by the eigenvector associated to this resultant reciprocal matrix and requires only one eigen value calculation for the entire sample. The latter method does not consider at all the consistency of each respondent and was therefore discarded. One must note also that although the scaling derived from the two techniques is dependent on the coding used, the ranking is not affected by it.

A method of interest that might help achieve a better consensus and may lower the consistency ratios, is a combination of the AHP and the Delphi technique in which respondents, particularly the "inconsistent" ones, are asked to reevaluate the risks in the light of the results of the first stage of the opinion survey.

Other Applications

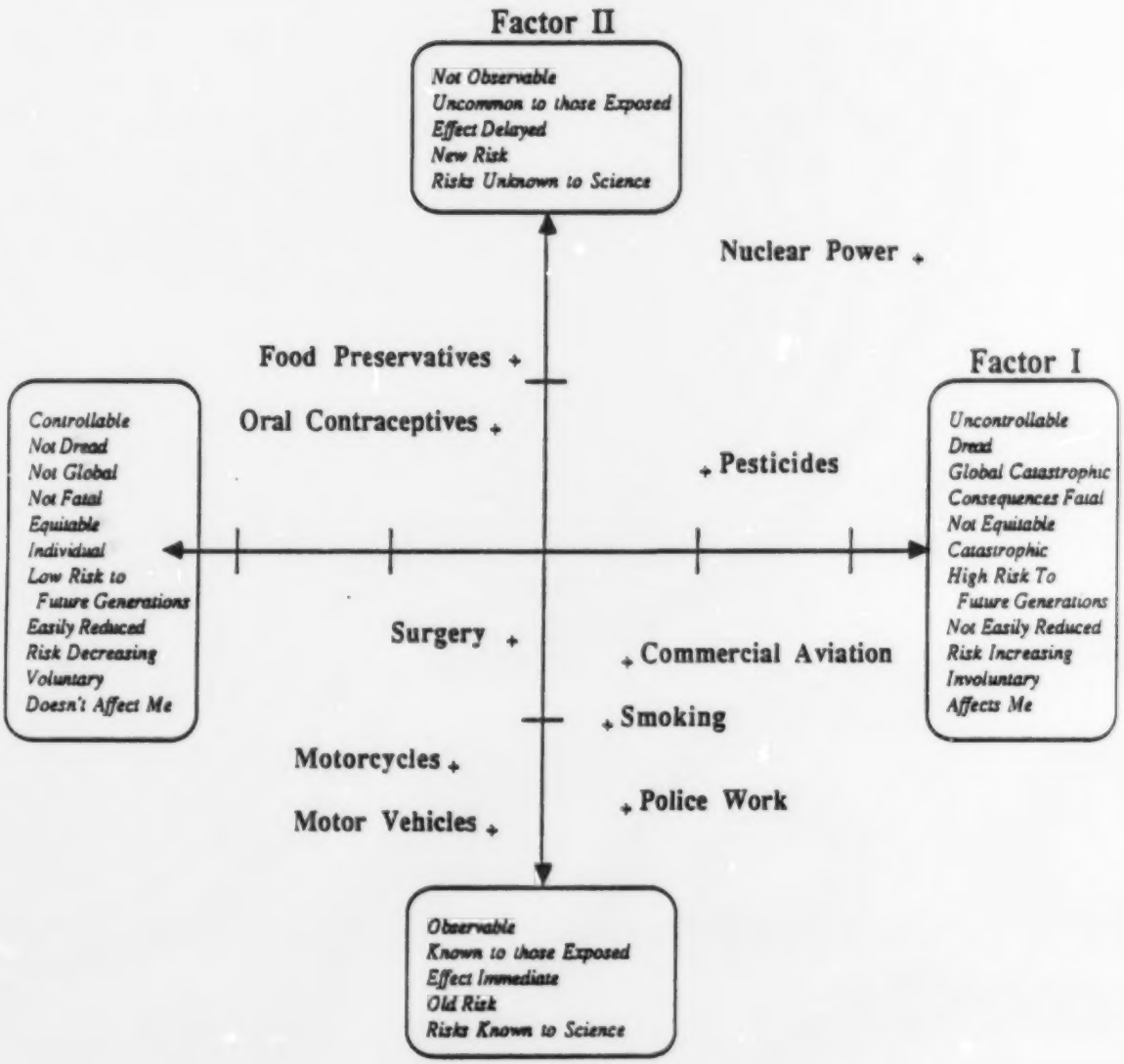
The description of the AHP method is only a one-level or one-hierarchy application. While this is what was used in the survey, a possible use of the full "hierarchical feature " of the AHP, for instance, might be to rank/scale a sub-set of risks on the factors identified by Slovic (Ref. 1) and shown at Table 6 and Fig. 2, or those being developed by Kasperson and Kasperson in their taxonomy of perceived risks (Ref. 6).

TABLE 6 : RISK CHARACTERISTICS

Voluntariness of Risks
Immediacy of Effects
Knowledge about Risk
Control over Risks
Newness
Chronic
Common Dread
Severity of Consequences

FIGURE 2 : HAZARD LOCATIONS ON FACTORS I AND II

(REFERENCE 1)



This would allow producing single numerical risk scales from multiple criteria paired comparisons. This type of exercise might contribute to explain certain observed inconsistencies in simple risk scaling methods. Of course, two-level AHP involving several distinct factors will soon make the opinion survey intractable due to the large number of paired comparisons it would require.

Conclusion

The number of self-declared "moderately knowledgeable" respondents with CR<0.25, turned out to be only 38 out of 77 (49% of all respondents) and this is the largest category represented in the sample. Due to the experimental character of the survey, no provisions were made to ensure a balanced sample. While respondents could not be considered as risk experts, they were mostly from the emergency preparedness field or from academia and should consequently have had a better awareness and knowledge of risk analysis issues than the general population. In addition, male respondents outnumbered females by a wide margin. Statistical comparisons between categories are therefore precluded and accurate correlations with "reference" scalings or rankings could be questioned. The poor consistency performance, while it confirms the findings by other researchers, also restrains the number and the quality of comparisons that might be made. However, a certain number of relevant observations are in order.

The most important finding of the survey remains the high consistency ratio of most respondents. From a sample of supposedly aware people dealing with risk management, the Saaty threshold of CR<0.1 would lead to the rejection of a large percentage of the responses and, as a result, would provide a rather weak consensus or aggregated scale. It is interesting to note as well that so-called experts did not demonstrate any more consistency than the other moderately and non-expert categories. Mere lack of logic might explain that result, but other causes, on the methodology side, should be studied further.

Scale coding, for instance, would deserve some more formal investigation and the exact shape of the implicit scale used by respondents would require some experimentation. Similarly, ways to resolve inconsistencies should be looked into even though we did not attempt to use any at the analysis stage of the experiment.

Whether one compares scalings or rankings, between category or with reference data, the two methods seem to give almost similar results. As discussed in the paper, however, rank comparisons are safer in this context because calculated ranking is not affected by the scale coding scheme. The above applies to the AHP method only, since rankings are provided directly by the respondents in the Direct Method.

Because it allows for consistency assessment of the responses and for straightforward aggregation of the individual responses into a consensus judgement, the AHP method has demonstrated obvious advantages. Calculations, however, require the use of microcomputers and the breakdown of questions into a sequence of paired comparisons may lead to boring if not intractable questionnaires, particularly when a two-level analytical hierarchy process or a multi-criteria ranking of risks is planned.

Notation / Abreviations

A	dominance matrix
a_{ij}	element of matrix A
AHP	Analytical Hierarchy Process
CR	consistency ratio
EPC	Emergency Preparedness Canada
IC	index of consistency
λ_{max}	largest eigenvalue of matrix A
n	number of risks under consideration (n=10)
q	an arbitrary constant value
R_i	a substance/activity/technology that is health or life threatening
r	a relation between two risks : $R_i \; r \; R_j$
S_i	calculated scale value for risk R_i
w_i	weight assigned to risk i
w_i'	approximate weight for risk i (component i of the eigenvector corresponding to λ_{max})

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ANNEX A

RESULTS OF THE SURVEY ON RISK PERCEPTION

The sample size is 77 and results to all questions are given as frequency counts (percentage of re spondents).

Q1: On the subject of risks, do you consider yourself as very, moderately, or not at all knowledgeable ? Check one please.

I am	very	5	knowledgeable
	moderately	79	
	not at all	16	

Q2: First, please rank the following 10 risks by order of severity: the risk with rank 1 being the riskiest and the one with rank 10, the least risky.

* Second, for the risks with ranks 1 to 9, indicate how many times riskier they are compared to the least risky one (i.e. the one with rank 10).

	RANKS									
	1	2	3	4	5	6	7	8	9	10
Aviation (Commercial)	0	0	4	5	4	10	17	18	25	17
Contraceptives	0	1	3	1	6	8	12	16	26	27
Food Preservatives	1	0	3	4	6	6	21	16	22	21
Motorcycling	42	27	19	6	3	1	0	1	0	0
Driving a Car	17	23	14	17	16	6	3	4	0	0
Nuclear Power	1	3	3	5	4	6	8	19	17	34
Pesticides	1	8	9	10	17	25	17	10	1	1
Police Work	4	14	5	19	23	17	8	5	4	0
Cigarette Smoke	19	10	27	16	12	19	1	5	0	0
Major Surgery	14	13	13	16	9	10	14	5	5	0

* *See main paper for summarized results to this subquestion*

ANNEX A

RESULTS OF THE SURVEY ON RISK PERCEPTION

Q3.1 : In your opinion, how does the risk listed on the LEFT side of the form compare with the one on the RIGHT. Please tick one square on each of the scales.

IS/ ARE	MUCH LESS RISKY		LESS RISKY		SAME		RISKIER		A LOT RISKIER		THAN
Aviation (Commercial)	9	8	3	21	7	4	5	23	9	1	10	Contraceptives
"	4	7	7	18	5	7	9	25	3	5	10	Food Preservatives
"	58	8	7	13	3	1	1	3	0	1	5	Motorcycles
"	34	17	12	22	5	0	1	1	3	0	5	Motor Vehicles
"	10	3	7	9	10	8	13	18	5	7	10	Nuclear Power
"	12	6	8	28	16	6	8	5	5	3	3	Pesticides
"	17	12	10	29	9	9	3	6	1	0	4	Police Work
"	41	13	10	21	3	0	0	4	3	1	4	Smoking
"	30	12	14	18	4	5	4	5	4	1	3	Surgery
Contraceptives	8	7	1	10	14	23	17	12	1	4	3	Food Preservatives
"	60	13	6	6	0	3	3	3	0	3	3	Motorcycles
"	49	14	9	16	0	1	1	4	3	0	3	Motor Vehicles
"	18	3	5	10	12	10	10	9	7	0	16	Nuclear Power
"	19	5	8	24	7	18	3	12	4	0	0	Pesticides
"	26	13	17	18	7	4	5	8	0	1	1	Police Work
"	44	16	14	12	4	4	0	3	1	0	3	Smoking
"	38	8	15	17	3	4	0	9	1	1	4	Surgery

☐ : % of respondents

ANNEX A

RESULTS OF THE SURVEY ON RISK PERCEPTION

Q3.2 : In your opinion, how does the risk listed on the LEFT side of the form compare with the one on the RIGHT. Please tick one square on each of the scales.

	IS/ ARE	MUCH LESS RISKY		LESS RISKY		SAME		RISKIER		A LOT RISKIER		THAN	
Food Preservatives		58	16	10	10	0	1	0	0	1	1	3	Motorcycles
"		42	18	13	14	1	3	0	3	3	0	3	Motor Vehicles
"		14	12	5	12	5	7	13	12	5	5	10	Nuclear Power
"		18	8	9	21	14	15	9	3	3	0	0	Pesticides
"		31	12	23	15	5	3	3	4	3	1	0	Police Work
"		47	17	10	10	3	7	3	0	1	1	1	Smoking
"		37	14	12	21	3	1	1	4	1	1	5	Surgery
Motorcycles		0	0	1	4	6	4	12	31	8	9	25	Motor Vehicles
"		5	0	1	1	1	1	3	13	5	11	59	Nuclear Power
"		1	0	0	9	0	4	3	21	13	19	30	Pesticides
"		1	1	3	4	0	3	13	26	16	13	20	Police Work
"		5	0	4	14	4	4	8	18	13	9	21	Smoking
"		4	1	1	8	4	7	10	16	16	10	23	Surgery

: % of respondents

ANNEX A

RESULTS OF THE SURVEY ON RISK PERCEPTION

Q3.3: In your opinion, how does the risk listed on the LEFT side of the form compare with the one on the RIGHT. Please tick one square on each of the scales.

IS/ARE	MUCH LESS RISKY		LESS RISKY		SAME		RISKIER		A LOT RISKIER		THAN
Motor Vehicles	5	3	0	3	3	1	4	12	14	18	37	Nuclear Power
"	3	4	4	8	3	3	5	21	13	14	22	Pesticides
"	1	0	4	17	4	8	12	16	17	7	14	Police Work
"	8	4	7	14	5	12	8	24	5	8	5	Smoking
"	8	5	4	7	7	9	10	20	9	14	7	Surgery
Nuclear Power	24	7	7	27	9	9	7	0	4	1	5	Pesticides
"	27	12	17	22	6	2	3	6	4	0	1	Police Work
"	43	10	14	12	3	1	0	4	0	5	8	Smoking
"	30	13	9	22	8	3	0	6	3	1	5	Surgery
Pesticides	9	9	15	21	9	5	8	13	5	5	1	Police Work
"	17	17	13	15	9	9	3	9	5	0	3	Smoking
"	17	10	12	19	8	8	9	5	3	3	6	Surgery
Police Work	10	8	16	16	9	9	5	6	8	4	9	Smoking
"	13	9	1	16	8	13	7	10	5	3	10	Surgery
Smoking	7	4	7	9	4	12	3	15	15	9	15	Surgery

☐ : % of respondents